[redacted]

[redacted]

Subject: Request for Proposal: RD-6-64

[redacted]

In response to the subject Request for Proposal, No. RD-6-64, [redacted] is pleased to submit a proposal for a Modulated-Light Film Viewing System.

In the technical proposal which is contained in the enclosed Report No. E-2163 entitled Modulated-Light Viewing System, four (4) alternate approaches are discussed as follows:

Paragraph 2.1:	Cathode Ray Tube Scanning System
Paragraph 2.2:	Photochromic System
Paragraph 2.3:	Variable-Intensity, Variable-Position, Scanning and Reading System
Paragraph 2.4:	Contrast Control by Compound Illumination.

Also submitted herewith are price proposals for each of the four approaches which are presented in two phases, Phase I comprising a Feasibility Study for each approach, and Phase II consisting of Operational Prototypes. The proposed prices are as follows:

	Par. 2.1	Par. 2.2	Par. 2.3	Par. 2.4
Feasibility Study	[redacted]			
Estimated Cost				
Fee				
Total				
Operational Prototy[redacted]				
Estimated				
Fee				
Total				

[redacted]

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Subject: Request for Proposal: RD-6-64

Phases I & II Combined
Estimated Cost [redacted] 25X1A
Fee
Total

The proposed fee has been computed by application of weighted guide lines in accordance with ASPR 3-808.4. Detailed cost breakdowns in support of the above summarized price proposals are presented on the attached exhibits. An applicable Certificate of Current Pricing is also enclosed herewith.

The feasibility study for alternate 1 is anticipated to extend over a period of eight (8) to (9) months, whereas the time required for pursuing similar studies for alternates 2, 3 and/or 4 will be slightly less. The results of the respective feasibility studies will be compiled in a detailed technical report at the end of Phase I. Operational prototypes together with instruction manuals can be furnished six (6) months after approval of the results of Phase I and receipt of authorization to proceed with Phase II.

The various technical approaches submitted herewith for your consideration have been generated by several of [redacted] engineering talents. We would welcome further discussions with you concerning the various ideas presented in order to arrive at a mutual understanding of the problems to be resolved and the desired results to be obtained in consequence of this projected program. 25X1A

As requested in the transmittal letter of the subject Request for Proposal, returned herewith is said letter together with enclosures.

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If further information is desired concerning the subject proposal, please contact [redacted] on technical matters and [redacted] who is authorized to negotiate a contract, on administrative details.

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Very truly yours,

[redacted]

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Approved For Release 2002/01/02 : CIA-RDP78B04747A002500050022-6

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TECHNICAL PROPOSAL

MODULATED-LIGHT FILM VIEWING SYSTEM

PHASE I FEASIBILITY STUDY

PHASE II OPERATIONAL PROTOTYPE

This material contains information affecting the national defense of the United States within the meaning of the Espionage Laws, Title 18, U.S.C., Sections 793 and 794, the transmission or the revelation of which in any manner to an unauthorized person is prohibited by law.

GROUP 1
EXCLUDED FROM AUTOMATIC
DOWNGRADING AND
DECLASSIFICATION

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[redacted]

 [redacted]

CONFIDENTIAL

E-2163
20 April 1964

TECHNICAL PROPOSAL

MODULATED-LIGHT FILM VIEWING SYSTEM

PHASE I FEASIBILITY STUDY

PHASE II OPERATIONAL PROTOTYPE

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SECTION 1
INTRODUCTION

Four basic methods of achieving a light-modulating system for direct viewing of roll film positives (or negatives) are described. The methods are compatible with the overall objectives of the request for proposal and range from relatively simple improvements in light tables to a cathode-ray-tube scanning system.

25X1A [redacted] has, for more than a decade, been vitally concerned with the scanning and precise measurement of nuclear detonation films of all test operations. In typical film records, very high density fireball images are surrounded by low film densities. The limitations of conventional light tables are, therefore,
25X1A well-known to [redacted] and considerable effort has been expended in developing improved equipment and techniques. In addition to these
25X1A improvements, [redacted] has considered the application of photochromic materials and cathode-ray-tube scanning systems.

Section 2 describes the four proposed design approaches individually; however, it may be that a combination of methods, or elements of methods, will result in the most practical system. This thought should be kept in mind in evaluating the methods. In the cost estimates which accompany this technical proposal, each method has been costed separately for both the feasibility study and the prototype phases. Estimates for combinations other than noted herein will be furnished on request.

SECTION 2

PROPOSED METHODS

2.1 CATHODE-RAY-TUBE SCANNING SYSTEM

For the application of CRT scanning systems to the modulated-light film viewing system, all the basic optical and electrical elements can be adapted from those employed in TV and similar instrumentation. Essentially, a television flying-spot scanner is proposed as the source of illumination for the light table. This scanner will differ from the conventional type in that the spot will be modulated in brightness by a self-generated electrical signal. Thus, the film transparency will, in essence, be laid over an image of the transparency and the image adjusted for maximum enhancement of the transparency. No registration problem will be encountered since the same spot that generates the signal will also produce the image. Processing of the electrical signal will allow such treatment as gamma correction, black and white stretch or compression, edge or transition enhancement, and other effects. These effects can be either operator controlled or optimized for specific conditions. A block diagram of the proposed system is shown in Fig. 1.

The generator for the flying spot will be a projection type television picture tube. Some tubes of this type (e.g., Type 7NP4) are capble of brightness levels of 30,000 foot-lamberts at their maximum ratings — obviously much more than is required for the light table, but illustrative of what can be done. The raster produced on this cathode ray tube will be imaged by an anamorphic optical system for the specific viewing area. It should be possible to use the same CRT and electronics with different optical systems for the 10 in. x 20 in. table, the 10 in. x 40 in. table, and the 30 in. x 30 in. projection viewer. The feasibility study in this area will be primarily concerned with selection of the proper tube from the several available, and a study of the mechanical and optical problems of the three desired configurations. The actual electrical drive circuitry

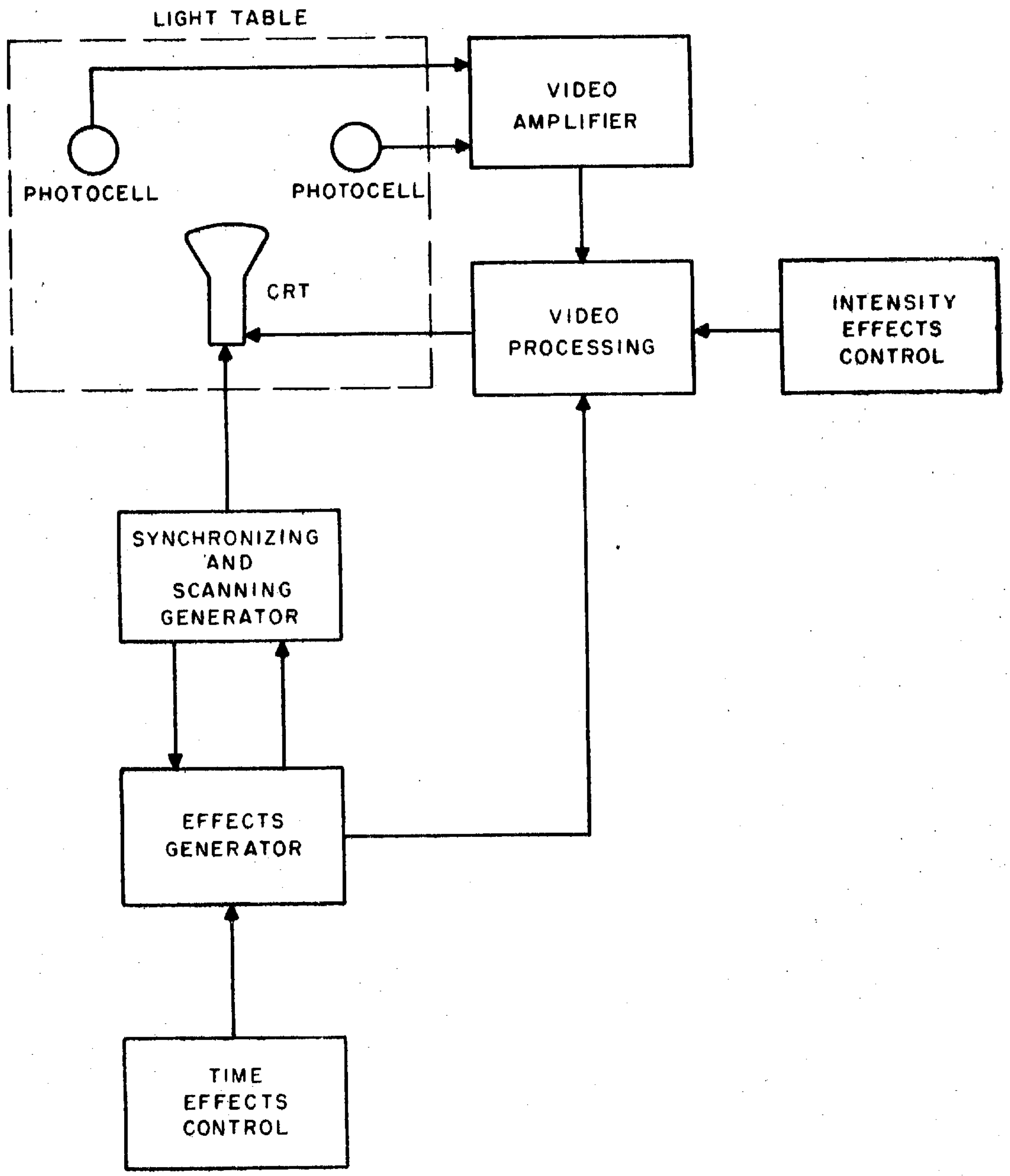

Fig. 1. Block diagram, proposed cathode-ray-tube scanning system.

has been well developed in the large screen projection television monitors, as typified by such commercially available equipment as the Telebeam, TelePrompter Amphicon, and others. It is proposed that one of these units be used as the basis for the breadboarded equipment, with suitable modification of the optical system.

Insofar as the interference of the television line structure with the image is concerned, it is proposed to investigate the possibilities of flying-spot shaping and "dot-wobble" techniques, both of which have been investigated and applied to some extent in television systems. For specialized applications, it has been possible to reduce the line structure so as to have negligible system effect, and it appears that such work will be applicable in this equipment.

For the breadboarding of the equipment, we propose to maintain the standards of commercial-broadcast, home-entertainment television equipment because of the abundant availability of signal processing units designed to such standards. It is recognized that this choice may not be optimum and an examination of the factors contributing to an optimum choice will be an essential part of the feasibility study. In effect, a simplification of equipment may result; however, the quantities of data available on both subjective and objective effects at standard television rates makes this approach well worth pursuit.

Based on this premise, a wide range of equipment becomes available for application to this problem. There are processing amplifiers to operate on the overall system gamma function, to stretch or compress whites and/or blacks, modify phase and frequency response, emphasize or de-emphasize edge transitions, and perform like functions. In the time domain, shading generators may provide overall control of intensity levels or be made to operate on particular areas of the total viewing field. Effects keying circuits can be applied to intensify or blank particular areas of the field, with keying signals extracted from electronic matrices, physical shapes or, under certain conditions, from the video signal itself. It will be the purpose of this protion of the feasibility study to determine just how the techniques and technology can best be applied to the subject problem, with special emphasis on simplicity of operation and minimum eye fatigue.

For this program it will be necessary to supplement television equipment on hand at [redacted] with the more specialized units for effects generation and signal processing. Such units are not often applied in routine industrial television applications. The units immediately available include an E1A sync generator, sync lock, stabilizing amplifier, aperture compensation amplifier, grating generator, monoscope and vidicon cameras and several monitors.

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In the initial feasibility study and breadboarding, it should be possible to employ a standard monitor as the flying-spot light source, without the optical system. This can be accomplished simply be overlaying a transparency on the face of the monitor tube, with a photocell pickup operating from transmitted light, and signal processing occurring in the amplifier circuits of the vidicon camera. For final proof of performance, however, a setup of the nature shown in Fig. 2 will be required. It will be left to the customer to determine whether this task is to be considered a part of the feasibility study or prototype construction, but for the purposes of this proposal, it is planned that the projection type monitor will be used for breadboard phases of the program.

2.2 APPLICATION OF PHOTOCHROMIC MATERIALS

For the past four years [redacted] has been actively engaged in the development of photochromic goggles and shutters to protect against the intense flash of nuclear detonations. Therefore, we feel adequately qualified to propose the following method, with variations, based on theuse of photochromic materials.

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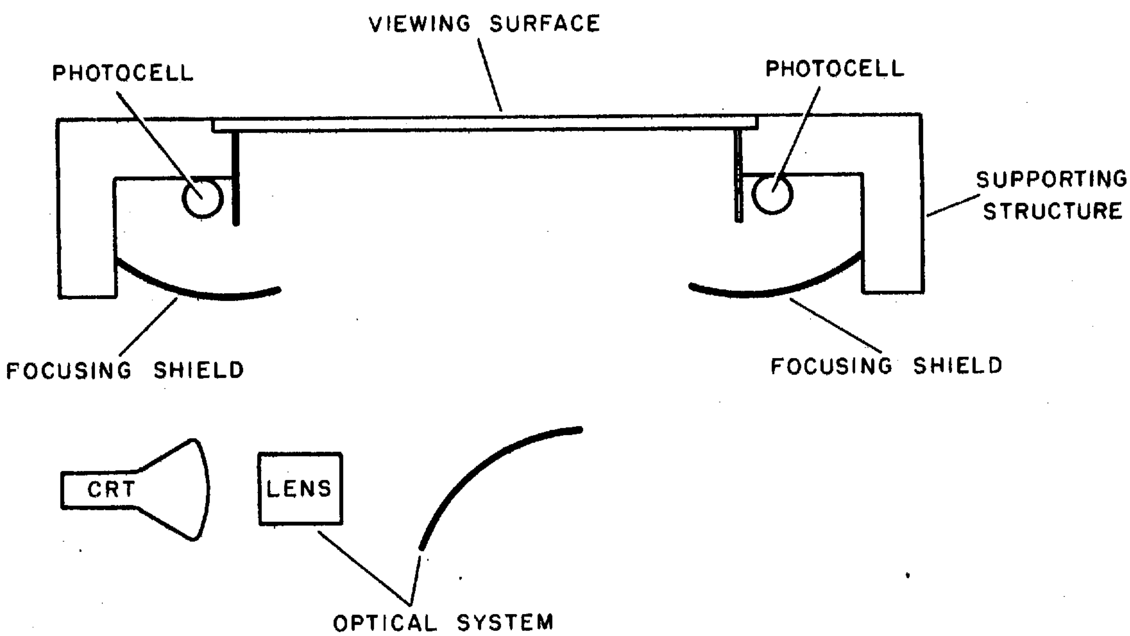

Fig. 2. Optical layout, proposed cathode-ray-tube scanning system.

The basic method is shown in Fig. 3 (A). In addition to conventional diffuse lighting, a sheet or plate of photochromic material is placed directly above the film. A hand-held "magic wand" light generator will be used to direct a beam of ultraviolet energy on to the desired spot on the photochromic material. A focus adjustment will permit the photo interpreter to vary the size of the projected spot. When the photo interpreter is confronted with a very-low-density area directly adjacent to a very-high-density area, he can use his "wand" to "paint in" (darken) the photochromic material directly above the low-density portion of the photograph and thus reduce the contrast and improve his ability to read detail in the denser portions.

Figure 3 (B) shows an alternate scheme wherein the photochromic material is placed below the photographic film. In this case, the photo interpreter will focus his "magic wand" for a large spot and the photographic film will then differentially absorb the ultraviolet energy from the "magic wand". The light from the opal glass directly beneath a low-density portion of the negative will be attenuated by the darkened photochromic material whereas there will be very little attenuation below a dense portion of the photograph.

Figure 3 (C) is a further modification which could be used in conjunction with the "magic wand". Here, a large-area ultraviolet source would be used to expose the entire photographic area and thus lower the contrast.

25X1A [redacted] considerable experience has been with organic photochromic materials. These materials vary in the position and width of their absorption band, in sensitivity, and in fading rate. They can be used in liquid form or can be dispersed in a plastic material. In the unactivated state, they are relatively clear and will not interfere with normal scanning. The density of the activated photochromic materials will depend upon the amount of ultraviolet energy supplied by the "magic wand".

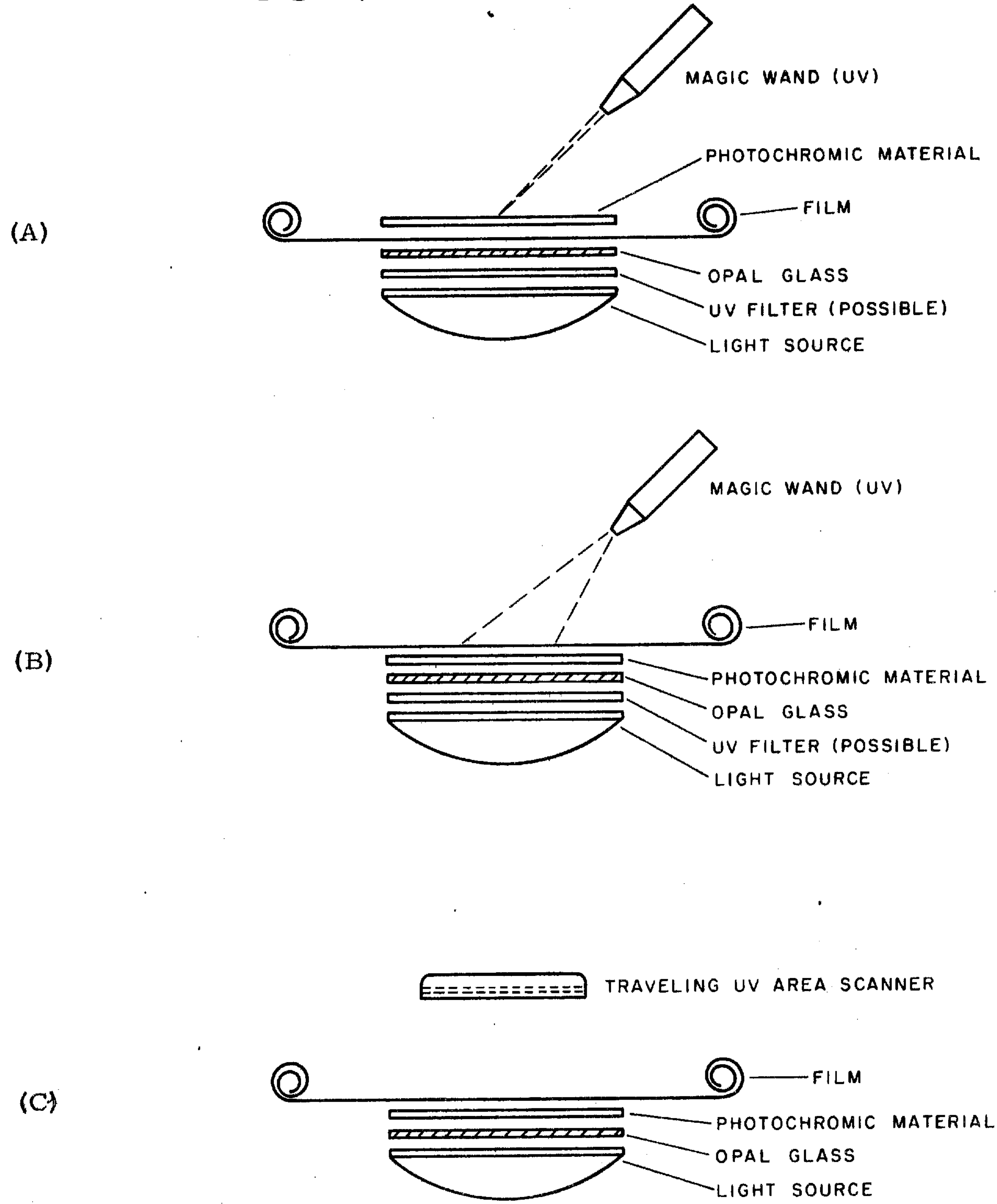

Fig. 3. Proposed methods utilizing photochromic materials.

Densities of 2.0 or greater should not be difficult to obtain. (In some of the [redacted] eye protective systems, densities as high as 4.0 are obtained, but this requires the use of so-called side band filters in conjunction with the most sensitive photochromic materials. The purpose of the side band filters is to absorb light energy outside the absorption band of the photochromic material, thereby preventing "light leaks" at the blue and red ends of the spectrum. Such a high density system appears colored even when the photochromic material is unactivated. In this proposal, we suggest the use of photochromic materials with broader absorption bands and the elimination of all side band filters.) Our experience indicates that a sufficiently powerful "magic wand" can be built to permit the use of such photochromic dyes in the configuration of Fig. 3 (A). The situation is a bit more difficult in the methods depicted in Figs. 3 (B) and 3 (C), since the film base absorbs some of the ultraviolet energy. However, we believe the later methods are feasible and warrant investigation.

Some of the organic photochromic materials fade in a second or two while others take minutes. We predict that a fading rate of two to five seconds will be desirable, and that such a fading rate can be achieved. However, it is possible the photochromic plate will have to be operated at an elevated temperature, or that an auxiliary infrared source may be necessary.

Fatigue of the organic photochromic materials may prove to be the most serious drawback to their use. If this is true, it will be necessary to design a relatively inexpensive photochromic plate which can be disposed of or recoated periodically. On the other hand, we may be able to optimize the life of the material by proper choice of dye content in or on the plate.

Recently, there has been considerable publicity about the new silver-halide photochromic glasses that have been developed by the

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[redacted] Although we have not worked with these new materials, we believe their published characteristics indicate that they should be seriously considered in this application. At this time, they appear to have both advantages and disadvantages when compared with the organic photochromic materials. For example, they are reported to be almost completely free of fatigue, their form in a glass plate is ideally suited to the present need, and they are quite neutral in color. On the other hand, it is unlikely that a high density can be achieved with these photochromic glasses, their fading rate is relatively long for high-density materials (although operating at higher temperatures may improve this to some extent), and the thickness of the glass may make it difficult to obtain a sharply defined darkened area. It is probable that the fading time will be the most serious drawback. It should be noted that most of the photochromic glasses are activated by visible light and therefore would work well in the configurations shown in Figs. 3 (B) and 3 (C).

The ultraviolet light source in the "magic wand" will consist of a small enclosed high-pressure mercury arc, or a high-pressure, continuous xenon arc. Our experience in gas-filled tubes over the years will be particularly useful in designing the "magic wand". If a standard, high-pressure xenon arc cannot be found which is compatible with a small, highly efficient design, we will investigate the possibility of designing a special, concentrated high-pressure arc lamp for this purpose.

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To summarize, [redacted] proposes to investigate the methods illustrated in Fig. 3, utilizing both the organic photochromic materials with which we have had a great deal of experience, and the newer [redacted] photochromic glasses. It appears that fatigue may be the most serious difficulty associated with the organic materials, while the fading rate may be the most serious disadvantage with the photochromic glasses Our long experience in gaseous discharge lamps will be of particular help in designing a compact and efficient "magic wand". 25X1A

2.3 VARIABLE-POSITION, VARIABLE-INTENSITY SCANNING AND READING SYSTEM

In this system, the entire viewing area of the table will be back-illuminated by an operator-controlled, continuously variable fluorescent source. The operator will also have a joystick-controlled, small-area, light source having freedom of motion in both X and Y directions. The latter light source, whose position is determined at the discretion of the operator, will have a brightness range controlled by the radial position of the joystick. The brightness range will be from no illumination to a sufficient intensity to permit viewing of densities of 4.5 or greater. The light source will be mounted at the intersection of orthogonally mounted positioning bars similar to those used on large, flatbed plotters. The bright light source will consist of a filament source with an opal glass diffuser immediately in front of the filament, a beam focusing lens, and a vertical positioning apparatus to permit positioning of either the lens or the light source with respect to the film plane.

As larger areas are illuminated, the intensity of the light source can be increased to permit the same overall irradiance at the film plane as for smaller areas. In areas where extremely high densities are encountered adjacent to thin densities, it is apparent that the use of aperture masks is essential to prevent eye damage or at least eye fatigue. In this instance, it is conceived that two sets of overlapping jaws whose axes correspond to the X-Y axes can be mounted immediately behind the viewing screen, or near and just above the film plane. The size of the aperture in either the X or Y direction will be controlled by the operator from the console. It is also possible that photochromic materials (see 2.2) could be profitably employed in combination with the mechanically adjustable rectangular aperture mask. Practicality of the foregoing system is apparent since none of the components require breakthroughs in any state-of-the-art.

25X1A For over ten years, [redacted] has been faced with the problem of scanning and measuring thousands of nuclear weapon detonation films in which very high density fireball images are surrounded by low film densities. The solution to our film reading and scanning problem has been similar to that mentioned above; that is, the use of an X-Y variable, high-intensity light source positioned to illuminate any selected area of any density. High magnifications (magnifications vary from 1:1 to 50:1) and the use of varying-aperture, circular masks to crop out high intensity light transmitted through adjacent areas of thin density extend the capabilities of our photo interpreters.

25X1A [redacted] has found this system to be practical, simple, and reasonably free from eye fatigue. Certain features of the proposed system would represent advancements of the current [redacted] systems, namely, the joystick control and the varying size area of the bright-light source in the film plane, but these are not considered beyond the capability of state-of-the-art equipments. 25X1A

25X1A Based on [redacted] experience, it is felt that a profitable edge gradient enhancement can be achieved by "jiggling" the light source back and forth rapidly over a small area being observed either directly or through a microscope. It is proposed, therefore, than an automatic "jiggle" control also be incorporated in the operator's joystick console.

2.4 CONTRAST CONTROL BY COMPOUND ILLUMINATION

A relatively simple method of varying contrast over a considerable range is illustrated in Fig. 4. This method is based on the use of a controlled combination of transmitted and reflected light.

If the opal glass viewing surface of the light table has a diffuse reflectance of 50% and a maximum one-way transmission of 90%, the maximum brightness resulting from reflected light will range from 4% to 40% of the incident light — a ratio of 1:10. (The diffuse reflectance of the most dense portion of a black and white film is approximately 4%,

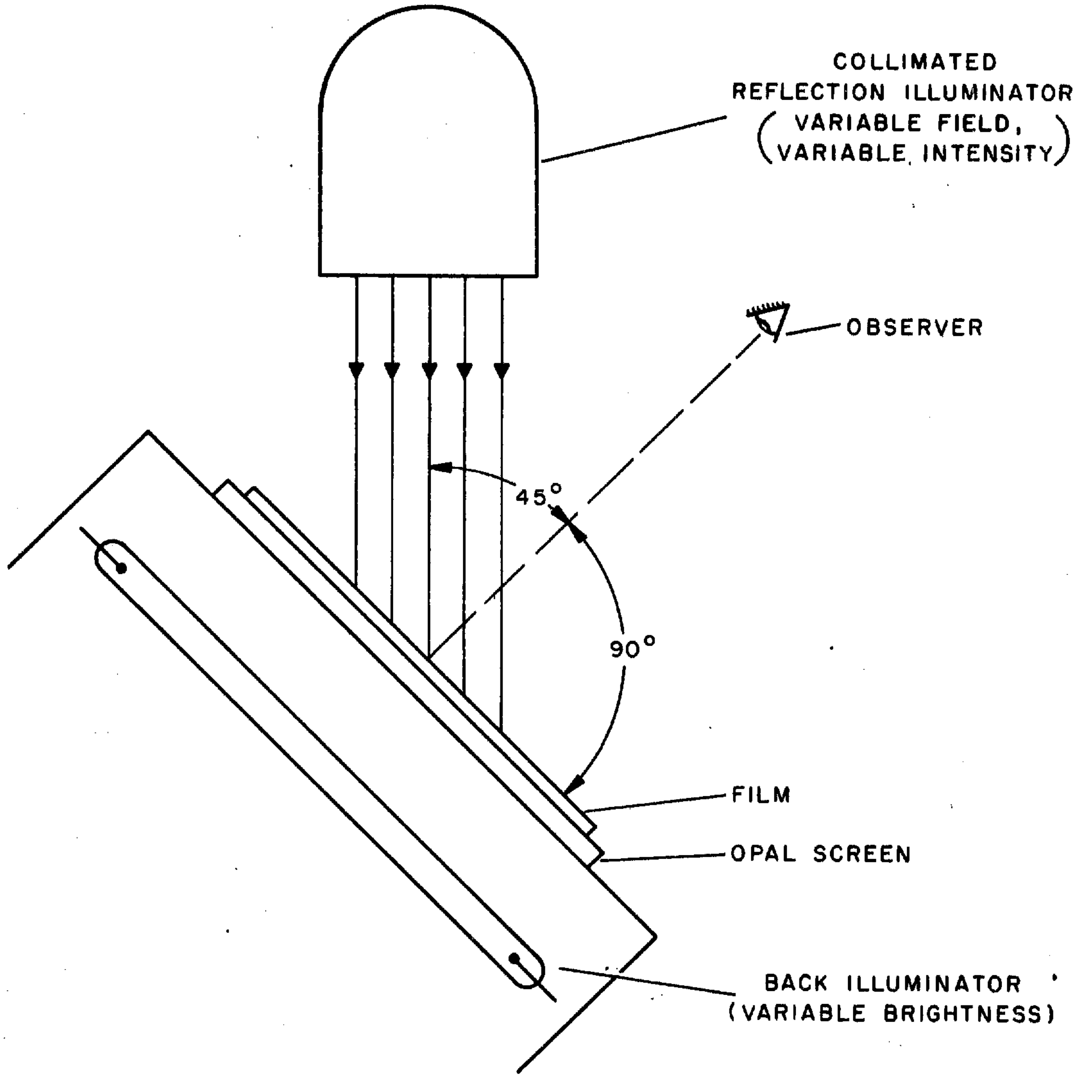

Fig. 4. Overall contrast control by compound illumination.

that of the least dense portion is approximately 40% (0. 5 x 0. 9 x 0. 9 x 100)). Pure specular reflection will be virtually eliminated under normal viewing conditions by using collimated light incident at a 45^{o} angle. Transmission illumination from back-lighting will result in a brightness variation corresponding to the density range of the film, which may be over four orders of magnitude. By varying the relative magnitudes of reflected and transmitted light, a considerable range of contrast control may be realized.

Another method based on the same principles, but primarily for local area illumination, is shown in Fig. 5. In this system, a partially-silvered specular screen with 50% transmittance and 50% reflectance is used in place of the standard opal glass, and local areas are illuminated by specular back light and diffuse forward light. By varying source intensity, contrast can be increased or decreased. The intensity of both light sources and the position of the specular back-light source in the X and Y directions are operator – controlled by means similar to those described in subsection 2. 3.

The principal advantages of the foregoing methods are design simplicity, operational simplicity, and low cost. The greatest disadvantage is that they do not offer the degree of information retrieval enhancement of more sophisticated and costly spatial frequency controlled illumination systems.

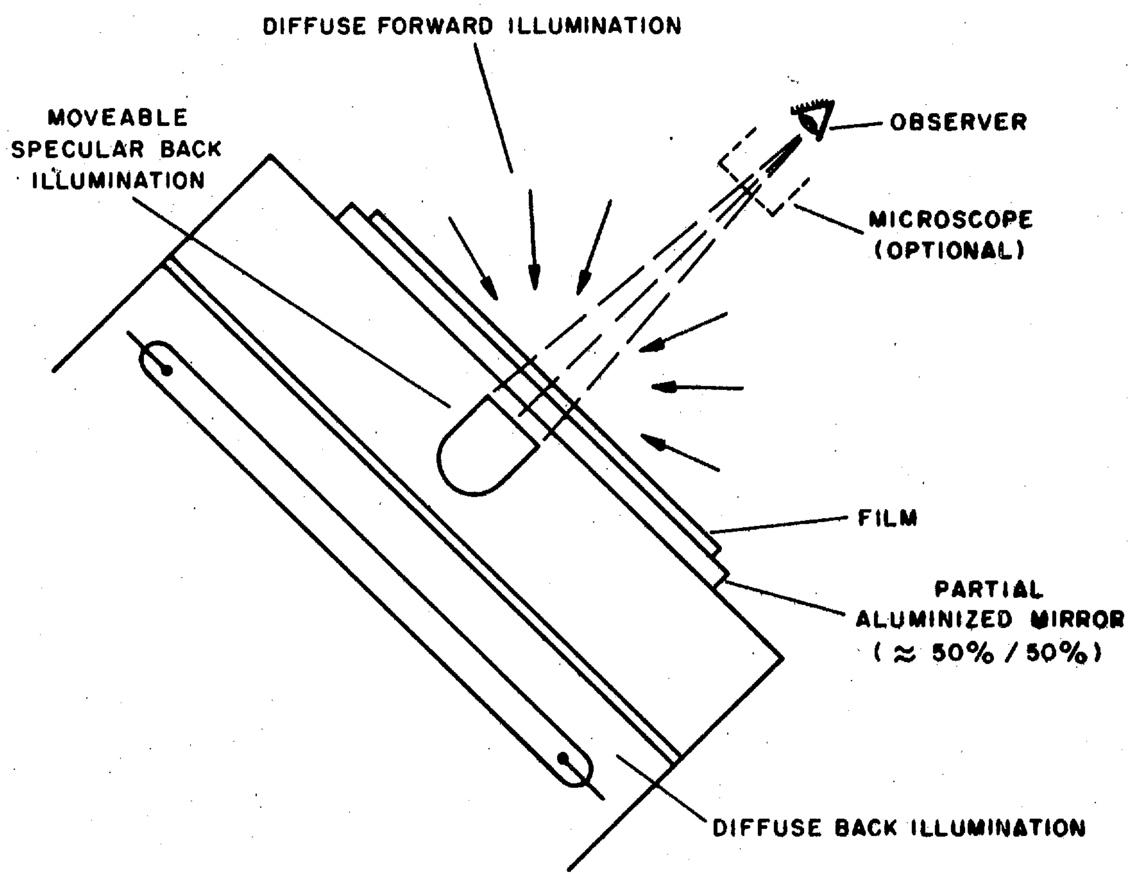

Fig. 5. Overall and local contrast control by compound lighting.

SECTION 3

PROPOSED PROGRAM

At the option of the procuring agency, any or all, or combinations thereof, of the methods described in Section 2 will be studied and breadboarded. The cathode-ray-tube scanning system feasibility study will require eight to nine months to complete — the other studies can be completed in less time.

Fabrication and testing of an operational prototype of any of the systems proposed can be completed six months from receipt of authorization to start.

A detailed engineering report covering the feasibility studies will be submitted at the conclusion of the Phase I work. A comprehensive instruction manual will be delivered with each prototype system.

SECTION 4

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Directly bearing on the subject proposal is the Company's experience in data analysis, particularly its experience in photogrammetric and photometric data reduction. For approximately 17 years, the Company has provided full technical and diagnostic film coverage of nuclear test operations and has scanned and measured all film records obtained. Photogrammetric analysis ranges from a quick-look scanning operation on a light table to precise measurements (0.0001-in. accuracy) with optical comparators. As a part of its data analysis program, [redacted] 25X1A continually researches new, and improved methods of data retrieval and processing. Improvements in light table design and usage have been noted in subsection 2.3.

Closed circuit television — the basic element of the proposed cathode-ray-tube scanning system — is regularly used in data acquisition
25X1A systems designed by [redacted] The application of this technique to a modulated-light viewing system is a logical extension of our work.

25X1A Since 1960, [redacted] has conducted research on flashblindness and is a leading developer of photochromic protective devices. In conjunc-
25X1A tion with the [redacted] and more recently with
25X1A [redacted] the Company has played an active part in the development of improved materials for light-filtering and shutter applications. Prototype protective goggles and optical shutters have been designed, fabricated, and tested.

25X1A [redacted] designed flashtubes, electronic flash systems, and illumination systems are used in a wide variety of applications. In designing high-performance flash systems for night aerial reconnaissance, [redacted] 25X1A personnel have become quite familiar with the task of the photo interpreter. Light distribution, shadowing, etc. are familiar terms, both to designers and analysts.

In addition to its experience and capabilities in the foregoing related fields, the Company's capabilities encompass all pertinent aspects of electrical, mechanical, and optical design and prototype fabrication and testing.

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